

WATER OPERATION AND MAINTENANCE BULLETIN

No. 199

March 2002



IN THIS ISSUE . . .

- ☞ 20-Year Performance of the Buried Geomembrane Lining at Mt. Elbert Reservoir
- ☞ Water Management Workshop – Water Measurement
- ☞ Water Management Workshop – Environmental Considerations

UNITED STATES DEPARTMENT OF THE INTERIOR

Bureau of Reclamation

Available on the Internet at: <http://www.usbr.gov/infrastr/waterbull>

This *Water Operation and Maintenance Bulletin* is published quarterly for the benefit of water supply system operators. Its principal purpose is to serve as a medium to exchange information for use by Bureau of Reclamation personnel and water user groups in operating and maintaining project facilities.

The *Water Operation and Maintenance Bulletin* and subject index may be accessed on the Internet at: <http://www.usbr.gov/infrastr/waterbull>

Although every attempt is made to ensure high quality and accurate information, the Bureau of Reclamation cannot warrant nor be responsible for the use or misuse of information that is furnished in this bulletin.

For further information about the *Water Operation and Maintenance Bulletin* or to receive a copy of the index, contact:

Jerry Fischer, Managing Editor
Bureau of Reclamation
Inspections and Emergency Management Group
Code D-8470
PO Box 25007, Denver, Colorado 80225-0007
Telephone: (303) 445-2748
FAX: (303) 445-6381
Email: jfischer@do.usbr.gov

Cover photograph: *Photo of a ramp flume, which was easily installed in an existing canal lining. This water measurement device is accurate and is not affected by moss buildup in the downstream channel.*

Any information contained in this bulletin regarding commercial products may not be used for advertisement or promotional purposes and is not to be construed as an endorsement of any product or firm by the Bureau of Reclamation.

WATER OPERATION AND MAINTENANCE BULLETIN
No. 199—March 2002

CONTENTS

	<i>Page</i>
20-Year Performance of the Buried Geomembrane Lining at Mt. Elbert Reservoir	1
Water Management Workshop – Water Measurement	3
Water Management Workshop – Environmental Considerations	15

20-YEAR PERFORMANCE OF THE BURIED GEOMEMBRANE LINING AT MT. ELBERT RESERVOIR

Abstract

The Bureau of Reclamation (Reclamation) has been using buried geomembrane canal and reservoir liners for about 40 years. It is assumed that the geomembrane liners have a design life of 50 to 100 years. Geomembrane manufacturers often cite laboratory-accelerated aging studies showing a theoretical service life of 1,000 years or even longer. The goal of this project is to predict geomembrane service life under actual field conditions. This project is funded by the Science and Technology Program. For a copy of the full report (MERL-01-01), contact Jay Swihart at (303) 445-2397; jswihart@do.usbr.gov or Erin Gleason at (303) 445-2382; egleason@do.usbr.gov

Summary

The Mt. Elbert forebay reservoir is part of the Mt. Elbert Pump-Storage facility (near Leadville, Colorado) that can generate 200 megawatts of electrical power during peak demand. Original construction of the reservoir with a compacted earth lining was completed in 1977. However, excessive seepage through the compacted earth lining was detected, and this seepage had the potential to reactivate an ancient landslide, endangering the powerplant below. Therefore, in the summer of 1980, Reclamation installed approximately 290 acres of 45-mil reinforced chlorinated polyethylene (CPER) geomembrane in the reservoir. The geomembrane was then covered with 18 inches of earth cover.

At the time of geomembrane installation, test coupons were installed immediately above the lining for monitoring long-term performance. The test section was divided into 11 separate test coupons to be exhumed for periodic testing of material properties as well as seam durability. Each test coupon measured 5 feet by 20 feet. To date, 8 of the 11 coupons have been removed and tested. The coupons were retrieved on a yearly basis for the first 5 years, then after 7 years of service (1987), after 10 years of service (1990), and now after 20 years of service (2000).

Performance

The geomembrane is performing well, with no visual signs of deterioration. Observation wells show that the water table levels are stable and that the geomembrane is essentially watertight. Many key physical properties have decreased 25 to 50 percent over the last 20 years, with most of the decrease in the first couple of years of service. Seam strengths have showed the greatest decline. The breaking strength of the CPER geomembrane and the shear strength of the Liester (hot air) seams are extrapolated out to 200 years in figures 1 and 2. Based on best-fit extrapolation of all the physical properties, a minimum service life prediction of 100 years seems reasonable and conservative.

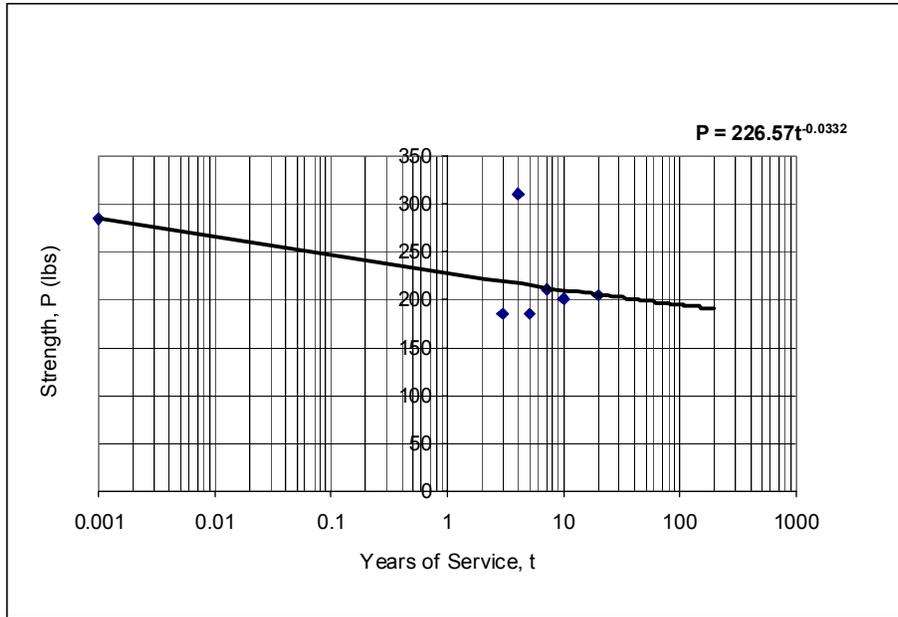


Figure 1

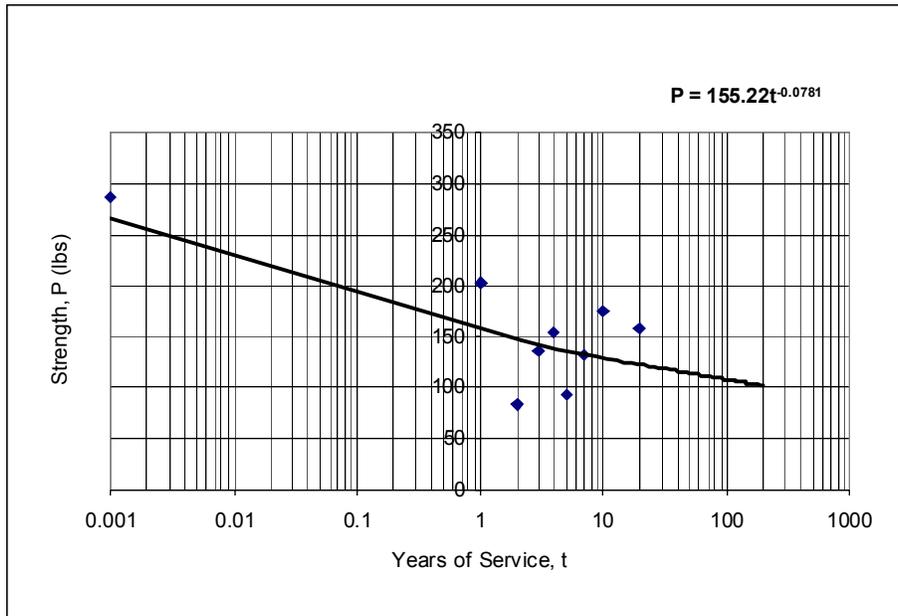


Figure 2

WATER MANAGEMENT WORKSHOP – WATER MEASUREMENT

by Jeff Peterson

The Need for Accurate Water Measurement

Ever-increasing demands for water by all users make it critical for water managers to ensure that the water they transport and deliver is accurately accounted for. Proper water measurement is the necessary means to accomplish this.

Accurate measurement of water is important for:

- ☞ Monitoring system efficiencies
- ☞ Determining delivery system losses
- ☞ Measuring the effectiveness of water conservation programs
- ☞ Charging water user accounts properly
- ☞ Ensuring fair water distribution to all users

Since almost all measuring devices that are improperly maintained or installed will deliver more water than they indicate, improper measurements can result in a significant economic loss to the managing organization and significant shortages to some users during dry years.

Many districts or water management entities have reached the point where their water supply is no longer sufficient to meet the users' demands. These entities are now looking for additional sources of water to meet these new demands. Conservation programs are being undertaken to gain additional water supplies. One of the best water conservation programs that a managing entity can undertake is to increase the accuracy of water measurement. As stated before, inaccurate devices almost always deliver more water than they indicate. When no measuring device is used, water delivery estimates are usually greater than indicated to reduce the risk of confrontations and arguments. Consequently, significant amounts of water can be “saved” if mutually acceptable measuring devices are used.

Improving water measurement accuracy can also conserve water by reducing operational spills in an open system. The amount of water entering the system to meet demands can be closely regulated so that spills at the lower end of the system can be reduced or even eliminated.

Every cubic foot of water “saved” as a result of improving the measurement of water is more valuable than a similar amount obtained from a new source, if available, because the water saved can be produced at considerably less cost. In instances where new sources are not available, the water saved can be used to meet new demands or provide additional supplies during a drought. Accurate measurement of water requires proper installation and maintenance of the appropriate measurement device. Selection of the appropriate device can be a critical factor in obtaining accurate results. It is best to use standard devices since they are less expensive to operate. Their general use generates more supporting data, thereby making them potentially more reliable.

Standard and Nonstandard Measurement Devices

A truly standard device is one that has been fully described, accurately calibrated, correctly made and installed, and sufficiently maintained to fulfill the original requirements. Standard devices have generally been calibrated in laboratory tests so that standard discharge tables or charts may then be relied upon to provide accurate water measurements. The objective when installing and maintaining a standard device is to reproduce the same flow conditions in the field as those used during the laboratory calibration of the device. Maintaining a standard device requires only a visual check of a few specified items or dimensions to ensure that the measuring device has not deviated from the standard.

Many devices are nonstandard because they have not been installed correctly and, therefore, do not produce standard discharges. Although these commonly used devices may appear to be standard devices, close inspection often reveals that they are not, and they must be calibrated to provide accurate measurements. Thus, proper inspection and care during installation and/or construction of standard water measurement devices are characteristics of good management. In rare instances, a nonstandard device is selected for a particular measurement situation. However, more frequently, a district unexpectedly finds itself with a nonstandard device because a device has been installed improperly, is poorly maintained, is operated above or below the prescribed limits, has poor flow approach conditions, or is the only measuring device available because of lack of funds.

Accurate discharges from nonstandard structures can be obtained only from specially prepared curves or tables based on calibration tests, such as current meter ratings. Calibration tests are tedious and can be quite costly when properly performed. Measurements must be made at fairly close discharge intervals over the complete operating range to fully describe the discharge characteristics. Therefore, it is usually less costly to install standard devices and maintain them. When checking a nonstandard device, it is difficult to determine by visual inspection whether accuracy is being maintained, except by recalibration.

Measuring devices themselves, rather than the flow conditions, may be at fault in producing measurement errors. The faults may be divided into two types: (1) faults caused by normal wear and tear and (2) faults resulting from poor installation.

It is possible to obtain inaccurate discharge measurements from regularly maintained equipment that was properly installed in an ideal location if poor measuring techniques are used by the operator. Measurement of head is very important, and some of the techniques now in use are not suitable for accurate measurements.

Approach Flow

Large errors in discharge can occur because of poor flow conditions just upstream from the measuring device. In general, the approaching flow should be tranquil. Any deviation from a uniform horizontal or vertical flow distribution, or the presence of water surface boils, eddies, or fast currents, is reason to suspect the accuracy of the measuring device.

Sand, gravel, or sediment bars in the approach channel or weeds or riprap obstructions along the banks can cause unsymmetrical approach flow. Other causes may be too short of a distance downstream from a check structure, turnout, or other source of high-velocity or concentrated flow; a bend in the channel just upstream from the measuring device; or an eddy which concentrates the flow in part of the cross section.

Turbulence

Turbulence is the phenomenon of relatively small volumes of water moving in a random pattern within the flow mass as it moves downstream. Turbulence may be recognized as water surface boils or swirls which appear and disappear in a haphazard way. Because of this local motion within the general motion of the flow mass, any particle of water may, at any given instant, be moving forward, sideways, vertically, and even backward. In effect, the water is passing a given point with a start-and-stop motion rather than with a uniform velocity that is ideal for flow measurement. Some turbulence is present in almost all natural and manmade channels and can be tolerated, but excessive turbulence will adversely affect the accuracy of any measuring device.

Poor Workmanship

In contrast with the measurement devices which were once accurate and dependable but have deteriorated are devices which, because of poor workmanship, were never a standard device. These include devices installed out of level or out of plumb, those that are skewed or out of

alignment, those with leaking bulkheads with flow passing beneath or around them, and those that have been set too low or too high for the existing flow conditions. Inaccurate dimensions can also cause measurement error.

Weathered and Worn Equipment

An unwelcome but fairly common sight on older irrigation systems is a weir blade that was once smooth and sharp, but now in a state of disrepair—the edges are now dull and dented; the blade is pitted with large rust tubercles; weir bulkheads are not vertical; weir blades have sagged and are no longer level; staff gages are worn and difficult to read; stilling well intakes are buried in sediment or partly blocked by weeds or debris; Parshall flumes are frost heaved and out of level; structures have settled; exit channels are clogged with vegetation, debris, and sediment; meter gates are partly clogged with sand or debris; and the gate leaves are cracked and warped.

These and other forms of deterioration are often the source of serious errors in discharge measurements. This type of deficiency is difficult to detect because normal wear and tear may occur for years before it is apparent to a person who sees the equipment frequently. Therefore, periodic independent reviews are recommended.

Rundown measuring devices are no longer standard measuring devices, and indicated discharges may have considerable errors. To be certain of the true discharge, the devices should be rehabilitated and/or calibrated.

Proper management of a water measurement device requires routine maintenance. However, preventive maintenance is better in terms of public relations and employee morale and, on a long-term basis, is less costly than reactive maintenance performed after breakdown or as a result of customer complaint.

Practically all measuring devices, when in rundown condition or when improperly installed, deliver more water than they indicate. The very nature of most measuring devices makes it impossible for a device to deliver less water than it indicates. Therefore, water accounting records may not show a proper division between water used and water lost through seepage or waste. Proper evaluation of losses is necessary to establish the economic feasibility of providing canal linings. Canal linings obviously cannot help recover water lost through poor measuring equipment or procedures.

Exit Flow Conditions

Exit flow conditions can cause as much (or more) flow measurement error as some of the approach flow problems. Sharp-crested weirs should always be operated so that the tailwater pool does not submerge the weir blade and so that there is good aeration of the bottom side of

the free-flowing nappe. If these two conditions are met, the weir will operate as a free-flow device, and other flow conditions in the downstream pool cannot affect the discharge rating. On the other hand, flumes and broad-crested weirs can operate either as free-flow devices or with partial submergence. When operating as a free-flow device, exit flow conditions will not affect the discharge rating of the device. However, with partial submergence (i.e., tailwater level above the crest), tailwater conditions can affect the discharge rating. In these flow situations, it is imperative that the submergence not exceed the allowable limit for the device, and the exit channel should allow flow to exit the device uniformly (e.g., not concentrate on one side of the flume due to a bend or other feature of the downstream channel). For some devices, a second water level measurement may be required in the downstream pool if the device is operating under partially submerged conditions.

Faulty Head Measurement

Improper gage location or an error in head measurement can result in large discharge errors. Readings obtained from stilling wells, whether they are visual or recorded, should be questioned, unless the operator is certain that the well intake is not partially or fully clogged. Readings from gages or staffs which may have slipped should be disregarded. Periodic checks of gages should be made with a level.

Infrequent Measurement

When a head or velocity measurement is made to determine discharge, it can be concluded that the measured discharge occurred only at the moment of the measurement. It cannot be concluded that the discharge was the same even 5 minutes later or 5 minutes earlier. Therefore, water deliveries can be accurate only if enough measurements are made to verify that the discharge did or did not vary during the water delivery period.

In many systems, measurements are made only once a day or only when some mechanical change in supply or delivery has been made. Problems introduced by falling head, rising backwater, and gate changes are often ignored when computing a water delivery.

Use of Wrong Measuring Device

Every water measuring device has limitations. It is impossible to choose one device that can be used in all locations under all possible conditions. It is to be expected, therefore, that for a given set of conditions there may be several suitable devices. It is possible that the wrong

device was selected in the first place. Whatever the reason, there are instances where accurate measurements are being attempted using a device that cannot, even with the greatest care, give the desired results.

Long-Throated Flumes and the WinFlume Computer Program

The term *long-throated flume* describes a broad class of critical-flow flumes and broad-crested weir devices used to measure flow in open channels. These devices are typically the most economical open-channel flow measurement devices and are adaptable to a variety of measurement applications in both natural and manmade channels and in both new and existing canal systems. The third edition of the *Water Measurement Manual* (see below for details) recommends long-throated flumes over Parshall flumes for most new installations because of their low cost, adaptability, and improved accuracy under partially submerged flow conditions.

Primary differences between long-throated and Parshall flumes are:

- ☞ Long-throated flumes have a control section that is horizontal in the flow direction rather than the inclined floor in the throat of the Parshall flume.
- ☞ Long-throated flumes are computer designed and calibrated, allowing the use of custom-designed flumes without the disadvantages previously listed for nonstandard devices (i.e., manual calibration is not needed). The *Water Measurement Manual* also provides tables of standard designs and rating equations that allow for selection and use of long-throated flumes without computer analysis.

The primary advantages of long-throated flumes, compared with weirs and other types of flumes, include:

- ☞ Assuming critical flow occurs in the throat, a rating table specifying the flow rate as a function of the upstream head can be determined with an error of less than 2 percent in the computed discharge. Rating tables can be computed for any combination of a prismatic control section and an arbitrarily shaped approach channel.
 - ☞ The throat must be horizontal in the direction parallel to the flow, but can be any shape in the direction perpendicular to the flow, allowing the complete range of discharges to be measured with good precision.
 - ☞ Accurate rating tables can be computed using as-built dimensions. The throat section may also be modified, as necessary, to accommodate changing site conditions, and a new rating can be computed using the modified dimensions.
-

- ☞ The required head loss across the flume is minimal to ensure a unique relationship between the upstream sill-referenced head and the discharge. Long-throated flumes can be operated with partial submergence (i.e., downstream water level above the sill elevation), and the submergence limit can be estimated for any structure placed in an arbitrary channel. Measurement accuracy when partially submerged is superior to that of Parshall flumes.
- ☞ Properly designed long-throated flumes can pass both floating and submerged debris.
- ☞ Long-throated flumes are typically the most economical structures for measuring open-channel flows.
- ☞ Because long-throated flumes can be designed for installation into any arbitrary channel, they are very adaptable to installation in existing canals.

Several generations of computer programs have been available since the mid-1980s for the design and calibration of long-throated flumes. The Bureau of Reclamation (Reclamation) and the U.S. Department of Agriculture's Agricultural Research Service (ARS) have most recently written the *WinFlume* program, which operates in a Windows-based computing environment. This updated software includes significant user-interface improvements and new features, and overcomes incompatibilities between Windows 95 and the copy-protection system used on the previously available DOS-based software. New features include an improved design optimization scheme, integrated printing of full-scale wall gages, improved graphics and units system support, and a simplified system for saving, retrieving, and sharing flume designs with other users.

The program can be used to develop rating tables and calibration equations for existing flumes and can also be used to develop new flume designs that meet user-specified design criteria, such as allowable head loss, desired freeboard in the approach channel, and necessary discharge measurement precision.

The new software was formally released in the fall of 1999 following beta-testing by users from Reclamation, ARS, and other agencies. The program and an electronic copy of the user's manual can be downloaded from the Internet at the following URL:

<http://www.usbr.gov/wrrl/twahl/winflume.html>

Reclamation's Water Conservation Field Services Program funded development of the *WinFlume* software.

The *Water Measurement Manual*

The information provided above is only an overview; if additional information is needed, reference the new third edition of Reclamation's *Water Measurement Manual*, which is now publicly available (see below for ordering information). This revised and updated edition supercedes the 1967 edition and includes several new chapters. Since 1953, Reclamation's *Water Measurement Manual* has been used by designers, system operators, and water users as the primary source for the latest information needed in accurate and reliable flow measurement of irrigation, municipal, and industrial waters.

The staff of Reclamation's Water Resources Research Laboratory (WRRL) collaborated with the staff of the U.S. Water Conservation Laboratory, ARS, to provide state-of-the-art information on flow measurement technology in the third edition. New chapters and sections were added to make the third edition current and more useful to other Government organizations.

The new chapters cover the following subjects:

- ☞ Basic concepts related to flowing water and measurement
- ☞ Selection of water measuring devices
- ☞ Measurement accuracy
- ☞ Inspection of water measurement systems
- ☞ Acoustic flow measurement systems
- ☞ Discharge measurements using tracers

With this edition, the *Water Measurement Manual* has also become the official manual for flow measurement in the U.S. Department of Agriculture.

Reclamation employees may order copies of the *Water Measurement Manual* by contacting the Property Operations Team (Warehouse) in Denver, mail code D-7913, Attention: Todd Marvel. Other agencies and the public can order copies from the Superintendent of Documents, U.S. Government Printing Office (GPO), PO Box 371954, Pittsburgh, Pennsylvania 15250-7954; by calling (202) 512-1800; or by faxing (202) 512-2250. The GPO stock number is 024-003-00180-5, and the cost is \$34 in the U.S. and \$42.50 for international purchases. The *Water Measurement Manual*, as well as other information related to flow measurement technologies, is available on the WRRL website at the following URL: <<http://ogee.do.usbr.gov/fmt/wmm>>.

Please feel free to browse this site and give us your feedback on how we can better serve your needs.

Water Measurement Discussion Forum

A new feature of the WRRL website is our Water Measurement Discussion Forum. This web-based discussion group allows you to post your water measurement questions on a publicly accessible web page, where staff from the WRRL, as well as other water measurement professionals, can see and respond to them. If you think someone else may have a good answer to your question, but you're not sure where to ask first, try visiting the discussion forum at: <http://ogee.do.usbr.gov/fmt> and click on "Public Discussion Forum" on the left side of the page.



Photo showing an example of a rectangular weir with the staff gage located far enough upstream to be out of the drawdown area.



Photo showing a bolt-together ramp flume that was first assembled on the bank and then placed in the ditch.



Photo showing a "rated section" where a staff gage is fixed in the concrete section, and a number of water measurements are taken with a current meter to determine a discharge rating curve. A recording shelter is also located at this site.



Photo of a ramp flume, which was easily installed in an existing canal lining. This water measurement device is accurate and is not affected by moss buildup in the downstream channel.

WATER MANAGEMENT WORKSHOP – ENVIRONMENTAL CONSIDERATIONS

by Vic Grizzle and Will Tully

Introduction

Very often, when people first hear about the National Environmental Policy Act of 1969 (NEPA), it is at public meetings where they have come to learn about, or provide input for, some proposed action. Many people do not understand the various environmental laws, rules, and regulations that the Bureau of Reclamation (Reclamation) must address, or how they, as Reclamation's clients and partners, fit into the process. You may ask: Why should I be concerned with environmental considerations, since we don't have an Animas-La Plata Project, or spotted owls, or grey wolves on our district? The answer is that the processes and products associated with compliance with environmental legislation often affect you. These processes and products are no better than the input they receive. Your participation can improve the quality of the products and ensure that your concerns are addressed.

NEPA is not the only environmental legislation that we need to be concerned with or that causes confusion. The purpose of this discussion is to explain some of the more common environmental considerations that district members may encounter. There are numerous laws that deal with the environment. However, in this discussion, we will focus on a few that are most likely to affect you. Even when dealing with only a few laws, there is a great deal of information that could be covered. However, to facilitate understanding, the discussion will focus on those sections of the laws and the material that will most likely affect you, with emphasis on how you can become involved in the process. The laws to be discussed include:

- ☞ NEPA
- ☞ Fish and Wildlife Coordination Act (FWCA)
- ☞ Endangered Species Act (ESA)
- ☞ Clean Water Act (CWA)
- ☞ National Historic Preservation Act (NHPA)

The focus of the discussion will be about NEPA and how compliance with other regulations is coordinated with the NEPA process. The emphasis will be on the process and not the interpretations of the law. We will begin with a simplified interpretation of NEPA and then focus on how Reclamation implements it and how that implementation affects water districts. The underlying intent of NEPA is to involve interested parties in the planning process.

In contrast to NEPA, the FWCA and the ESA are more oriented toward Government agencies (i.e., one agency develops a report for another agency without much, if any, public input). However, agencies are encouraged to integrate various compliance activities under the “umbrella” of NEPA. Reclamation attempts this integration and, when successful, public concerns can permeate throughout the NEPA process and into other compliance activities.

Different levels of studies and different levels of compliance will be covered and appropriate examples discussed during the session. Emphasis will be given to familiar example studies (i.e., contract renewals, title transfer, and water conservation). During the workshop sessions, a Categorical Exclusion Checklist (CEC) will be reviewed, a typical environmental assessment (EA) and Finding of No Significant Impact (FONSI) described, and a full environmental impact statement (EIS) and Record of Decision (ROD) addressed. Finally, integration of the FWCA and ESA into the NEPA process will be discussed and specific questions that should be addressed during the process will be presented. Throughout the discussion, emphasis will be placed on where and how people can get involved in the process.

National Environmental Policy Act

NEPA, according to the Council on Environmental Quality, “is our basic national charter for protection of the environment.”

The purpose of NEPA is to facilitate the disclosure and sharing of relevant information concerning a proposed action and its potential effects on the human environment. Notice that we are speaking of the human environment, not just fish, wildlife, etc. The NEPA process also ensures that all interested parties have an opportunity to participate in the planning of significant actions and that their concerns are heard by Reclamation or any agency involved in the process.

There are references to the NEPA process throughout this material; that process will be described in greater detail later. However, in general, the NEPA process:

- ☞ Requires participation by agencies and the public in the planning process
- ☞ Requires full disclosure about the action, alternatives, impacts, and possible mitigation
- ☞ Brings out environmental concerns

- ☞ Allows environmental impacts to be considered while planning the action
- ☞ Results in informed and better decisions

The goals of NEPA, including public participation, disclosure, consideration of impacts, etc., become more important and more prominent in the process and in documentation as the actions become more complex and the potential for adverse impacts increases. However, NEPA is not a cure-all.

What NEPA does *not* do:

- ☞ Decide which alternative to choose (participants in the process recommend a *preferred alternative*; however, the decisionmaker decides which alternative will be implemented)
- ☞ Prevent environmental impacts from occurring (impacts can and do occur, regardless of the NEPA process)
- ☞ Guarantee wise decisions (decisionmakers base their choices on available technical and political information)
- ☞ Prohibit any actions (alternatives may be considered that are outside agency authority; however, if selected, authority must be obtained before implementation can occur)
- ☞ Justify a predetermined action (NEPA occurs during the planning process and before action implementation)
- ☞ Require mitigation for all environmental impacts (Reclamation mitigates, whenever possible)

For more complex studies, NEPA provides for agency and public involvement and a documentation process. NEPA documents are resources used by decisionmakers. However, the documents themselves do not guarantee the decision. There are three levels of documentation. Depending on project complexity and degree of environmental impact, NEPA documentation can occur through categorical exclusions (CEs), EAs, or EISs. Each of these documents and the process associated with their development are discussed below.

Categorical Exclusion.—The purpose of a CE is to document NEPA compliance for actions that would result in less than significant or no environmental impacts. A CE applies to actions that do not individually or cumulatively have a significant effect on the human environment. For example, routine maintenance activities and other similar tasks that do not cause significant impacts are generally handled, in terms of NEPA compliance, with a CE.

The CE generally consists of a brief description of the action and a CEC. The CE is not an exemption from NEPA but a determination that the action does not require an EA or EIS.

A CEC is used as the primary documentation of the CE. A CE is justified when all criteria can be responded to with “no.” A CE concludes NEPA compliance for small actions without significant impacts. CEs are the most common form of NEPA compliance at the area office level when dealing with local issues.

Criteria to be addressed in a CE include:

- ☞ Will this action or group of actions have a significant effect on the quality of the human environment (yes/no/unknown)?
 - ☞ Will this action or group of actions involve unresolved conflicts concerning alternative uses of available resources (yes/no/unknown)?
 - ☞ Will this action have significant adverse effects on public health or safety (yes/no/unknown)?
 - ☞ Will this action have an adverse effect on unique geographical features such as wetlands, wild or scenic rivers, rivers in the nationwide inventory, refuges, flood plains, or prime or unique farmlands (yes/no/unknown)?
 - ☞ Will this action have highly controversial environmental effects (yes/no/unknown)?
 - ☞ Will this action have highly uncertain environmental effects or involve unique or unknown environmental risk (yes/no/unknown)?
 - ☞ Will this action establish a precedent for future actions (yes/no/unknown)?
 - ☞ Is this action related to other actions with individually insignificant, but cumulatively significant, effects (yes/no/unknown)?
 - ☞ Will this action affect properties listed or eligible for listing in the *National Register of Historic Places* (*National Register*) (yes/no/unknown)?
 - ☞ Will this action adversely affect a species listed, or proposed to be listed, as endangered or threatened (yes/no/unknown)?
-

- ☞ Will this action threaten to violate Federal, State, local, or tribal law or requirements imposed for protection of the environment (yes/no/unknown)?
- ☞ Will this action affect Indian Trust Assets (yes/no/unknown)?

If any of these concerns can be answered with a “yes,” then at least an EA is required (see below). If the answer is “unknown,” then additional effort is required until a “no” answer is justified or the decision is made to elevate the effort to the EA level.

As we shall see shortly, the CEC includes the same resource issues and concerns that are addressed in more detailed NEPA documents. However, for small actions with no or insignificant impacts, extensive documentation is not required. The CEC addresses relevant concerns while minimizing time spent in documentation.

In summary, the CE addresses small common actions for which there are no significant environmental impacts and no controversy. As such, public involvement in the NEPA process that culminates in a CE is limited. If all criteria in the CEC can be addressed and the answers are all “no,” NEPA compliance for that action is concluded, and implementation can proceed.

Environmental Assessment.—The purpose of an EA is to permit the responsible official to determine whether to prepare a FONSI or an EIS. A FONSI terminates NEPA compliance for the action, while the need for an EIS elevates the effort. In practice, EAs are prepared for actions where the probability of a FONSI is high. If the action appears to warrant an EIS, then the study moves directly to that level of effort, and no EA is developed.

Depending on the level of complexity, the EA process may include:

- ☞ Joint environmental documentation with State and local agencies
 - ☞ **Scoping**
 - ☞ Consultation and coordination with other agencies
 - ☞ **News releases**
 - ☞ **Sending the draft EA to the public for comments**
 - ☞ **Public meetings on the draft EA**
-

☞ **Sending the final EA and FONSI to the public**

☞ Supplementing previous EAs

The bolded items above indicate areas in which Reclamation welcomes active public involvement in the NEPA process. Most individuals are familiar with public meetings where interested parties stand and voice their opinions “for the record.” This type of format is generally used when Reclamation is gathering official comments on a draft EA. However, of equal importance are scoping meetings held before alternatives are formalized. It is during these early sessions that public concerns become incorporated into the planning process.

EAs are generally brief documents of a few to 30-plus pages, but they always include discussions of the following:

- ☞ Purpose and need (for action)
- ☞ Alternatives (including No Action and the proposed action)
- ☞ Affected environment
- ☞ Environmental consequences
- ☞ Consultation and coordination

Reclamation attempts to follow a consistent format in its NEPA document so the public can easily find those sections that are of most interest. An EA begins with a brief discussion of the purpose and need for the action under consideration. This is followed by a description of the alternatives under consideration and, in more complex EAs, a discussion of those alternatives that were considered but eliminated from detailed analysis. This is generally the section where interested parties can determine how well Reclamation responded to information presented during scoping meetings. In general, EAs are only undertaken for actions in which there is a high probability that a FONSI is justified. In these cases, only the No Action and the proposed action are generally evaluated. The body of the EA is the section that describes what currently exists (often referred to as the affected environment) and predicts how current conditions would change (often referred to as the environmental consequences) under each alternative considered. Finally, there is a section describing who Reclamation contacted and how consultation and coordination occurred.

In summary, the EA addresses proposed actions that are more complex than those addressed in CEs but that do not involve the complexity and potential controversy that warrant an EIS. The goal of an EA is to address the proposed action, disclose its environmental impacts (if any), describe appropriate mitigation measures, and present all other relevant information to assist and support the decisionmaker in determining that the appropriate and justifiable conclusion to the NEPA process is a FONSI. If a FONSI cannot be justified, the study effort

is increased to the final level – an EIS. Note that as the complexity of the NEPA study increases, the importance and opportunities for public involvement increase.

Before leaving the discussion of EAs, a few words about mitigation seem appropriate. Although NEPA does not require mitigation of environmental impacts, it is Reclamation's policy to mitigate adverse effects of our actions whenever possible. *Mitigation* is not a “cookbook process” but, rather, a continuum of actions designed to eliminate impacts. Mitigation begins with efforts *to avoid impacts*. If impacts cannot be avoided, the next approach is *to lessen impacts*. Finally, as a last resort, *impacts are compensated*. In practice, mitigation is generally a combination of the approaches available. Mitigation is discussed further in the following EIS section.

Environmental Impact Statement.—The purpose of an EIS is to inform decisionmakers and the public of the proposed action, reasonable alternatives, and their environmental impacts. An EIS is the “cadillac” of NEPA compliance documents. An EIS is normally required for a major Federal action, one whose environmental effects are likely to be significant and/or controversial. The act of producing an EIS does not remove controversy; however, when properly executed, the NEPA process provides a forum for agencies and interested parties to come together and work through differences to find mutually acceptable solutions.

An EIS is generally more extensive and provides a more detailed treatment of material than an EA. Though more detailed, an EIS should present information in a nontechnical manner that ensures clarity and understanding of the resources, issues, and analyses. Technical analyses, such as streamflow or other hydrological data, are collected and available in appendices, but are usually not distributed unless requested. Depending on the level of complexity and/or controversy, an EIS may include:

- ☞ Joint environmental documentation with State and local agencies
 - ☞ **Scoping**
 - ☞ Consultation and coordination with other agencies
 - ☞ **News releases**
 - ☞ **Newsletters**
 - ☞ **Sending the draft EIS to the public for comments**
-

☞ **Public meetings on the draft EIS**

☞ **Sending the final EIS to the public**

Again, the bolded items above indicate areas in which Reclamation welcomes active public involvement in the NEPA process. Because of the complexities, and often controversy, involved in an EIS effort, it is extremely important that the public becomes involved early and stays involved during the entire process. By being involved, public concerns become incorporated into the planning process. In some cases, multiple or ongoing public meetings may be held.

EISs are usually larger documents, consisting of a few hundred pages but, like the EA, they include discussions of the following:

- ☞ Purpose and need (for action)
- ☞ Alternatives (including No Action and the proposed action)
- ☞ Affected environment
- ☞ Environmental consequences
- ☞ Consultation and coordination

Reclamation attempts to follow a consistent format in its NEPA document so the public can easily find those sections that are of most interest. An EIS begins with a brief discussion of the purpose and need for the action under consideration and addresses any other related actions that may be ongoing or planned. This is followed by a description of the range of alternatives under consideration (including the *preferred alternative*) and a discussion of those alternatives that were considered but eliminated from detailed analysis. Although not required by NEPA, Reclamation attempts to identify the preferred alternative in its draft EISs (the preferred alternative must be identified in the final EIS). This is usually the section where interested parties can determine how well Reclamation responded to information presented during scoping meetings and formulated that information into alternatives. The body of the EIS includes sections that describe what currently exists (affected environment) and predicts how current conditions would change (environmental consequences) under each alternative considered. Finally, there is a section describing who Reclamation contacted and how consultation and coordination occurred.

In summary, the EIS addresses proposed actions that are more complex than those addressed in CEs or EAs. Like an EA, the goal of an EIS is to address the proposed action, disclose its environmental impacts (if any), describe appropriate mitigation measures, and present all other relevant information to assist and support the decisionmaker in determining the appropriate alternative to select in the ROD.

The ROD is the decision document of the EIS process; it identifies the alternative selected for implementation and provides the rationale and justification for its selection. Although not required, the selected alternative is usually the preferred alternative identified in the EIS. The ROD also defines the *environmentally preferred alternative*, but this alternative need not be the preferred alternative.

Fish and Wildlife Coordination Act

Under the FWCA, Reclamation is required to consult with the Fish and Wildlife Service (Service) and the State wildlife agency during the planning of new projects and for the modifications to existing projects so that wildlife resources receive equal consideration and are coordinated with other project objectives and features.

Reclamation compliance with the FWCA requires:

- ☞ Consultation
- ☞ The opportunity for the Service and State wildlife agency to report
- ☞ Consideration of FWCA report recommendations
- ☞ Incorporation of justifiable wildlife features into the recommended plan or action
- ☞ Incorporation of the FWCA report as an integral part of the decisionmaking package (often appended to the EA or EIS)

The Service, working with the State wildlife agency, produces the report for Reclamation. The report usually contains information of the following nature:

- ☞ A description of the important existing wildlife resources of the area as well as future wildlife resource conditions with and without the proposed project
 - ☞ Wildlife resource problems, needs, and opportunities
 - ☞ Potential actions or measures available to address wildlife resource problems, needs, and opportunities
-

- ☞ Recommendations to mitigate adverse impacts of plan alternatives and/or to enhance resources
- ☞ Identification of potential alternatives under consideration that the wildlife agencies consider nonviable
- ☞ An analysis of technical data that supports anticipated project effects and results of implementing recommendations
- ☞ Land acquisition and easement recommendations
- ☞ An analysis of the cost effectiveness of recommendations
- ☞ Recommendations to refine present analysis in future studies
- ☞ Unresolved issues

The FWCA report often provides important information that is useful in the NEPA process. For this reason, Reclamation tries to begin coordination as early in the process as possible to ensure that the information is available for the EA or EIS. In general, Reclamation will include information from the draft FWCA report into the draft EA or EIS or, in some cases, append the entire document. By including information and/or appending the report, Reclamation provides the public with an additional opportunity to participate in the planning process.

There are two major differences between the FWCA report and NEPA documents. First, there is no public involvement; the FWCA report is a technical document written by one agency for another agency. Second, the report contains recommendations, and Reclamation is not required to accept the recommendations if it disagrees with them or finds them incompatible with project goals.

Endangered Species Act

The ESA was passed in 1973, has been amended several times, and has been due for reauthorization since 1993. It is a controversial law, and additional controversy surrounds its implementation. We will discuss the ESA and how compliance is generally coordinated with the NEPA process.

The purposes of the ESA are:

. . .to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved, to provide a program for the conservation of such endangered species and threatened species, and to take such steps as may be appropriate to achieve the purposes of the treaties and conventions discussed in the Act.

- (1) It is the policy of Congress that all Federal departments and agencies shall seek to conserve endangered species and threatened species and shall utilize their authorities in furtherance of the purposes of this Act.
- (2) It is the policy of Congress that Federal agencies shall cooperate with State and local agencies to resolve water resource issues in concert with conservation of endangered species.

The ESA contains 18 sections. Reclamation and our clients deal primarily with Section 7 and, to a lesser degree, Sections 9 and 10. Before beginning discussions of the ESA, some definitions are necessary.

Endangered Species Any species which is in danger of extinction throughout all or a significant portion of its range.

“Species” is defined as any subspecies of fish, wildlife, or plants and any distinct population segment of any species of vertebrate fish or wildlife that interbreeds when mature.

Threatened Species Any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Candidate Species Plants and animals considered for possible addition to the list of endangered and threatened species. Because these species have not been officially listed, they have no Federal protection. However, it is Reclamation's policy to treat candidate species as if they are listed.

Critical Habitat The specific areas within the geographical area occupied by the species at the time of listing, or specific areas within the geographic area which may not be occupied by the species at the time of listing but were historically, or may still provide, habitat. Both areas are considered essential to the conservation of the species and which may require special management considerations or protection.

Section 7 Consultation.—Section 7 deals with interagency cooperation, and the process is often referred to as “Section 7 Consultation.” This section requires Federal agencies, such as Reclamation, to consult with the Service (who represent the Secretary of the Interior) to ensure that any “agency action” is not likely to jeopardize the continued existence of any threatened or endangered species or result in the destruction or adverse modification of habitat for those species.

In practice, “informal consultation” begins with a request from an agency, such as Reclamation, to the Service requesting a list of threatened, endangered, and candidate species that may occur in or inhabit an area in which some action is planned.

The Service provides this list, and Reclamation conducts an evaluation of potential impacts to listed species that might result from the proposed project. The evaluation is formalized into a report known as a biological assessment. To reduce duplication and project costs, Reclamation often requests that the Service use the material presented in the NEPA document (EA or EIS) as the biological assessment.

If Reclamation determines that the proposed project actions “are not likely to adversely affect” listed species, and the Service agrees, consultation is concluded for that specific proposed project. However, if Reclamation determines that the proposed project “may affect” a listed species, then formal consultation begins. Formal consultation is conducted to determine if an action is likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of critical habitat. (Note that adverse effects may occur without constituting jeopardy.) In general, formal consultation extends for 90 days, unless all parties agree to extend the period. At the end of formal consultation, the Service has 45 days to render an opinion. Both agencies attempt to find mutually agreeable solutions to their differences during formal consultation.

The Service documents its official views of the proposed project in a report referred to as a biological opinion. In the biological opinion, the Service discusses the project and potential impacts to listed species. The biological opinion includes:

- ☞ A summary of the information on which the opinion is based
- ☞ A detailed discussion of the effects of the action on the listed species or critical habitat
- ☞ The Service's opinion as to whether the action is likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of critical habitat

In its discussion, the Service often identifies *conservation measures*. Conservation measures are actions believed by the Service to be important in reducing impacts to listed species.

The biological opinion concludes with either: (1) a “no jeopardy” opinion (i.e., the action is not likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat) or (2) a “jeopardy” opinion (i.e., the action is likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat).

The action may proceed if the Service issues a no jeopardy opinion or Reclamation adopts a reasonable and prudent alternative provided in a jeopardy opinion. A *reasonable and prudent alternative* consists of alternative actions identified during formal consultation that can be implemented in a manner consistent with the intended purpose of the action, that can be implemented consistent with the agency's legal authority and jurisdiction, that are economically and technologically feasible, and that the Service believes would avoid jeopardizing the continued existence of the listed species or result in the destruction or adverse modification of critical habitat.

An *incidental take* statement will be provided with the biological opinion when the activity may incidentally take individuals of a listed species, but not so many as to jeopardize their continued existence. If the action proceeds in compliance with the terms and conditions of the incidental take statement, then any resulting incidental takings are exempt from the prohibitions of “taking” clauses (see discussion in Section 9, below). In effect, the biological opinion, with the incidental take statement, acts as an exemption of the ESA.

In NEPA studies involving listed species, the biological opinion is an important component of the overall effort. Reviewers of draft EAs or EISs should carefully evaluate sections that deal with the biological opinion. Although not a part of NEPA, the biological opinion can greatly affect the outcome of the NEPA process, including the preferred alternative.

Section 9 – Prohibited Acts.—Taking listed species is prohibited, except where permitted. “To take” means to harass, harm, pursue, hunt, shoot, wound, trap, capture, or collect, or to attempt to engage in any such conduct. Harm is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering. “Harass” is defined as actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering.

Again, reviewers of NEPA documents should pay particular attention to the incidental take statement provided with the biological opinion.

Section 10 – Exceptions.—Identifies the exceptions to the prohibition on taking. A Section 10 permit to take would be required to avoid violation of Section 9. In situations involving Section 10 permits, water districts should work closely with Reclamation staff.

Clean Water Act

The purpose of the CWA is to “. . . restore and maintain the chemical, physical, and biological integrity of the Nation's water.” To do this, the CWA identifies the following goals:

. . . (1) that the discharge of pollutants into the navigable waters of the United States be eliminated by 1985; (2) that as an interim goal there be attained by 1983 water quality which provides for the protection and propagation of fish, shellfish and wildlife, and provides for recreation in and on the water; (3) that the discharge of toxic pollutants in toxic amounts be prohibited; (4) that Federal financial assistance be provided to construct publicly owned waste treatment works; (5) that area wide waste treatment management planning processes be developed and implemented to ensure adequate control of source pollutants in each State; (6) that a major research and demonstration effort be made to develop technology necessary to eliminate the discharge of pollutants into navigable waters, waters of the contiguous zone, and the oceans; and (7) it is the national policy that programs for the control of nonpoint sources of pollution be developed and implemented in an expeditious manner so as to enable the goals of this Act to be met through the control of both point and nonpoint sources of pollution.

The CWA achieves its goals through a system of water quality standards, discharge limitations, and permits. The CWA may affect water district operations in at least two ways. The first of these is through the Environmental Protection Agency's (EPA) water quality criteria.

CWA Water Quality Criteria.—Much of the geology of the Western United States contains various salt-bearing shales of marine origins. These shales contain various trace elements and other constituents that can become potentially problematic when they occur near the surface and become concentrated. One of the more common constituents is selenium.

Selenium is a naturally occurring, semimetallic trace element present in many geological formations, including soils, in the Western United States. While selenium is required for human and animal health in small quantities, it can be harmful at higher levels. The EPA water quality criterion for selenium is 5 parts per billion (ppb) to protect freshwater aquatic

life. Concentrations above 5 ppb in water may occur naturally or may result from man's activities. Higher levels of selenium become harmful, causing birth defects, reproductive failures, and mortality in fish, wildlife, and livestock.

Selenium can enter streams and other wetlands through natural runoff and/or through man-made pathways such as irrigation return flows. Levels of selenium above 5 ppb in water are a concern because the element can be bioaccumulated (i.e., taken up by an organism from water or through food and result in biomagnification). Biomagnification is the process by which the concentration of selenium (or some other constituent) increases as higher levels of the aquatic food chain feed on organisms that have bioaccumulated selenium. Selenium becomes incorporated in proteins, and these selenium-substituted proteins do not function properly and can lead to reduced reproduction, behavioral abnormalities, and physical deformities. Selenium is also transferred from parents to offspring through eggs and can result in embryonic deformities and death.

Reclamation is required to periodically sample irrigation return flows and determine their water quality. Elevated levels of selenium, other elements, and chemicals are associated with irrigation operations in several areas of the West. Elevated constituent levels can be managed efficiently if they are detected before they become problematic. Reclamation will work with the water districts whenever these types of problems are encountered.

CWA Section 404.—The second area of the CWA that can affect water districts is known as Section 404. Section 404 of the CWA is commonly referred to as the U.S. Army Corps of Engineers dredge and fill permit section. A Section 404 permit is generally required if activities will result in the placement of fill material into waters of the United States. Any type of repair work that involves machinery working within the streambed would generally require a Section 404 permit. If you are in doubt about your responsibilities under Section 404, contact your Reclamation field office or area office for clarification.

National Historic Preservation Act

The NHPA is designed to protect historic sites and values in cooperation with other nations, States, and local governments. Federal agencies, like Reclamation, are required to consider the effects of their undertakings on historic resources and to give the President's Advisory Council on Historic Preservation a reasonable opportunity to comment on those undertakings. Historic properties are generally 50 years and older. Many irrigation facility structures would fall into the definition of an historic property.

The NHPA requires Federal agencies to inventory resources and develop programs to protect historic resources. Federal agencies can charge reasonable costs to Federal permittees and

licensees for protection activities. NHPA compliance activities are usually addressed while conducting the NEPA process. An evaluation is conducted to determine whether a proposed action would affect districts, sites, structures, or objects listed in or eligible for listing in the *National Register*.

Reclamation uses three levels of surveys to locate and identify cultural resources. A Class I Survey is primarily a literature/archival search. This type of survey generally consists of consulting the *National Register* to determine if properties eligible for listing in the *National Register* exist in the area of a Reclamation proposed action. It also includes contacting the State Historic Preservation Office, State Archeologist, State Historian, State Historical Society, and/or other appropriate individuals, agencies, or institutions to determine what cultural resources may be present in an area and what kind of additional information may be needed for an adequate inventory of cultural resources. It may be necessary to visit potentially significant sites identified in the literature/archival search. If a Class I Survey indicates the area has not been adequately inventoried, a field examination is necessary.

A Class II Survey is an on-the-ground examination of a statistically valid sample of the total survey area. This type of survey may include remote sensing and/or geomorphological investigations or other appropriate techniques. Class II Surveys are designed to aid in determining if a Class III Survey is necessary. A Class II Survey may be combined with a Class I Survey or bypassed to conduct a Class III Survey.

A Class III Survey consists of an intensive, on-the-ground examination of all the areas to be affected by a Reclamation action or on lands under Reclamation's administration. It is designed to locate and make a preliminary professional evaluation of all identified cultural resources. All cultural resources identified as historically significant will be nominated to the *National Register* or a determination of eligibility will be sought. A Class III Survey may require excavations or other specialized studies to determine the significance of cultural resources.

Districts are encouraged to work closely with Reclamation's field offices or area offices when dealing with NHPA issues.

Integration of Environmental Considerations

As mentioned earlier, NEPA can serve as an “umbrella” for environmental considerations, especially those activities, such as the FWCA and ESA, that do not normally provide for public involvement. Both of these acts provide reports between agencies but do not provide a mechanism for public involvement in the planning process. However, the results of both reports are generally incorporated into either the EA or EIS. Draft EAs and draft EISs

incorporate the draft results or append the entire draft FWCA report and/or draft biological opinion when available. Information dealing with the CWA and the NHPA are treated similarly.

As discussed earlier, two of the purposes of NEPA are to facilitate participation by all interested parties and to ensure complete disclosure of information regarding impacts. The results of the FWCA report, biological opinion, and studies addressing the CWA and NHPA are important components of the information required by the public to assess the adequacy of the NEPA process.

As interested parties and participants in the NEPA process, including review of documents, make sure that some very basic questions are answered. Remember, NEPA requires that the public be given an opportunity to comment early in the planning (“scoping”) process and again when the draft NEPA document is released. This is minimal participation, and it should be taken advantage of. If this is the case, the following questions must be raised during the review of the draft document. If additional opportunity for public involvement is provided, it should also be taken advantage of, and the process should be viewed as positive and proactive.

- (1) Was the public given an ample opportunity to voice opinions and concerns during the planning process involving the development of an EA or EIS? If not, ask a Reclamation representative why.
 - (2) Is the preferred alternative clearly identified in the draft EA or EIS? If not, ask a Reclamation representative why. The public's ability to effectively comment is limited if the preferred alternative is not identified. A failure to identify the preferred alternative in the draft EA or EIS may indicate agency confusion or some other problem with the action or process.
 - (3) Is the topic of mitigation properly addressed? Does the level of mitigation appear reasonable?
 - (4) Is there adequate discussion and treatment of the FWCA report? Are the recommendations identified, and what is Reclamation's response? Was the response appropriate? If the information is not available, ask a Reclamation representative why.
 - (5) Is there adequate treatment of listed species concerned (threatened or endangered)? Did the EA or EIS serve as a biological assessment, or was a separate document developed? If separate, is the document, or its results, available for review? If the information is not available, ask a Reclamation representative why. If the information is not available at the time of review of the draft EA or EIS, ask a Reclamation representative why the NEPA process is continuing.
-

- (6) Is the biological opinion, or its results, available for review? Were conservation measures identified? Was a jeopardy or nonjeopardy opinion issued? What is the reasonable and prudent alternative? Is there an incidental take statement? If the information is not available, ask a Reclamation representative why. If the information is not available at the time of review of the draft EA or EIS, ask a Reclamation representative why the NEPA process is continuing.

The answers to these questions may directly affect you and/or district operations. Once again, it is important that the public become involved early in the NEPA process and stay involved.

Mission

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.



The purpose of this bulletin is to serve as a medium of exchanging operation and maintenance information. Its success depends upon your help in obtaining and submitting new and useful operation and maintenance ideas.

Advertise your district's or project's resourcefulness by having an article published in the bulletin—let us hear from you soon!

Prospective articles should be submitted to one of the Bureau of Reclamation contacts listed below:

Jerry Fischer, Technical Service Center, ATTN: D-8470, PO Box 25007, Denver, Colorado 80225-0007; (303) 445-2748, FAX (303) 445-6381; email: jfischer@do.usbr.gov

Vicki Hoffman, Pacific Northwest Region, ATTN: PN-3234, 1150 North Curtis Road, Boise, Idaho 83706-1234; (208) 378-5335, FAX (208) 378-5305

Steve Herbst, Mid-Pacific Region, ATTN: MP-430, 2800 Cottage Way, Sacramento, California 95825-1898; (916) 978-5228, FAX (916) 978-5290

Albert Graves, Lower Colorado Region, ATTN: BCOO-4846, PO Box 61470, Boulder City, Nevada 89006-1470; (702) 293-8163, FAX (702) 293-8042

Don Wintch, Upper Colorado Region, ATTN: UC-258, PO Box 11568, Salt Lake City, Utah 84147-0568; (801) 524-3307, FAX (801) 524-5499

Dave Nelson, Great Plains Region, ATTN: GP-2400, PO Box 36900, Billings, Montana 59107-6900; (406) 247-7630, FAX (406) 247-7898